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THE MATING BEHAVIOR OF *BROCHYMENA QUADRAPUSTULATA* (FABRICIUS)*

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Pentatomid reproductive behavior has been the subject of a number of papers (e.g. Kullenberg, 1947; Teyrovsky, 1949; Southwood and Hine, 1950; Leston, 1955; Kaufmann, 1966; Mitchell and Mau, 1969; Tostowaryk, 1971; Alcock, 1971; Fish and Alcock, 1973). These studies have revealed considerable diversity and complexity in the courtship activities of male pentatomids, raising questions about the evolution and ecological significance of these behaviors. Answers to these questions will require additional comparative data. We present information here on *Brochymena quadrapustulata*; loose aggregations of this cryptic species were observed on grapefruit (*Citrus paradisi*) and desert broom (*Baccharis sarothroides*) in suburban Tempe, Arizona, from 25 February to 17 May 1973. In addition to written records of field observations of eight courtships, super-8 films of three separate courtships leading to copulation were utilized for detailed analysis of the mating behavior of *B. quadrapustulata*.

RESULTS

Eight complete and three incomplete courtships were observed between 1145 and 1540 hrs. The components of mating are outlined chronologically below and illustrated in Fig. 1.

- (1) The male approaches the female (she may be moving or immobile at the time) and touches her with his antennae. If moving, the female may freeze with her abdomen held close to the branch on which she was walking or escape by running away.

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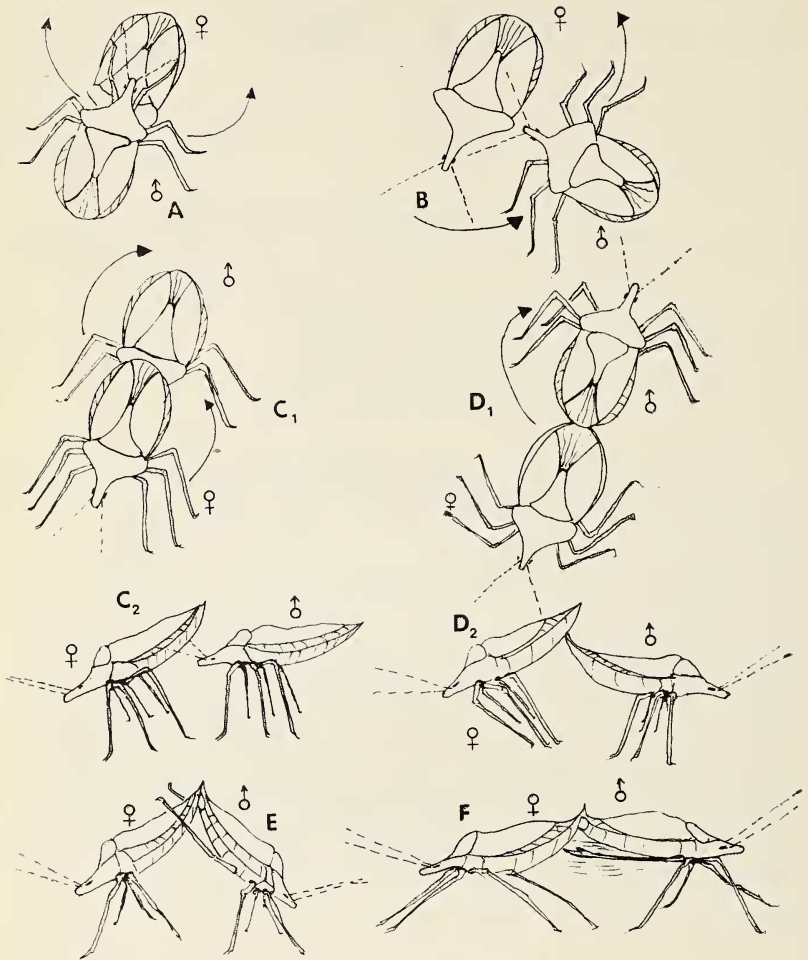


Figure 1. A diagram of the courtship of *Brochymena quadrapustulata*. A. The male's crab-like movements on the anterior dorsum of the female. B. The male moves to the rear of the female. C. The view from above and from the side of the male antennating the venter of the female's abdomen. D. The view from above and from the side of the male about to achieve genital linkage. E. Genital linkage in an end-to-end position. F. The male drumming on the side of the female with its hindlegs.

- (2) The male seizes the anterior or posterior dorsum of the female with his legs. Unreceptive females respond by breaking away from the male or by moving off with their partner clinging to them.
- (3) If the female is immobile, the male moves so as to face his mate while continuing to grasp the dorsum of her body. He then begins a rapid crablike walk from side to side over the anterior female dorsum. Receptive females gradually raise their abdomen in response to this activity. The male's back and forth movements varied from 20-34 in number and lasted from 23-43 seconds in four filmed courtships.
- (4) At some point the male moves off the anterior dorsum of the female and continues out along the side of his mate while constantly antennating her lateral surface.
- (5) The male, upon reaching the posterior of the female, sweeps his head under her elevated abdomen; his antennae move rapidly up and down in alternating strokes touching the female's abdominal venter. The male may prod and lift the body of unresponsive females which have not voluntarily raised their abdomens.
- (6) As the male's head passes under the body of the female he begins a tight 180° turn that brings him into the end-to-end precopulatory position. Unreceptive females may dash off down a branch as the male executes this maneuver.
- (7) The male elevates his abdomen while sweeping the aedeagus in a zig-zag pattern against the venter of the female's abdomen. Each sweep brings the male aedeagus progressively closer to the female genitalia; linkage occurs when mutual genital contact occurs.
- (8) Upon linkage, the insects' bodies jerk violently from side to side for several minutes. The coupled pair may move a short distance during this time.
- (9) The male rapidly drums the sides of the female's abdomen with his hindlegs (also observed by Ruckes, 1938, for *B. sulcata*). Spells of drumming are interrupted by pauses during which the male rests its hind legs on the dorsum of the female's abdomen. This continues as long as the partners are linked. One pair of stinkbugs remained *in copulo* for at least 75 min but had separated when observed 45 min later.

DISCUSSION

This report provides additional evidence that among the Penta-

tomidae it may not be uncommon for males to initiate copulation while facing directly away from the female. This behavior is rare among the Heteroptera (Weber, 1930). Below we have summarized the major methods by which pentatomids achieve genital linkage.

Genital linkage initiated in an end-to-end position

Brochymena (this paper), *Euschistus* (Alcock, 1971), *Nezara* (Mitchell and Mau, 1969), *Chlorochroa* and *Cosmopepla* (Fish and Alcock, 1973), *Perillus* (Esselbaugh, 1948), *Podisus* (Olsen, 1910)

Genital linkage initiated with male above female, both facing in same direction

Brochymena (Ruckes, 1938), *Dolycoris* (Teyrovsky, 1949), *Calidea* (Kaufmann, 1966)

Genital linkage initiated with female above male, both facing in same direction

Podisus (Tostowaryk, 1971)

We also have records of end-to-end matings in *Thyanta pallidovirens*. Males of this species, upon making contact with a female, begin antennating the surface of her body while moving to the tip of her abdomen. There they may prod and lift the female's body with their head before turning away from her. The female, if receptive, raises her abdomen slightly. Unlike other species which initiate copulation in a dismounted position, the male's body often forms a right angle with the female instead of a 180° angle. The male then kicks lightly at the rear of its partner's wingcovers and abdomen with its hind legs before inserting the aedeagus into the female's genital opening.

As Fish and Alcock (1973) have noted, species which employ the end-to-end method have highly similar courtship routines. Common characteristics include (1) male antennation of the female, (2) attempts by the male to lift the female's abdomen with its head, (3) abdominal elevation by receptive females, and (4) tactile stimulation of the venter of the female's abdomen with the antennae and aedeagus of the male. The male's "goal" in courtship appears to be to induce the female to adopt a position that will make insertion of the aedeagus relatively easy.

The unusual feature of the courtship of *B. quadrapustulata* is the rapid crab-like movement of the male over the head and thorax of the female, a behavior that may have evolved from efforts of males in the past to prevent physically the escape of females. Now the action may serve as a releaser of abdominal elevation by receptive

females. Interestingly, very similar behavior has been reported for the distantly related African pentatomid *Calidea dregii*, a member of the Scutellerini (Kaufmann, 1966).

Finally the fact that different members of the same genus (e.g. *Brochymena*, *Podisus*) may exhibit basically different methods of initiating genital linkage suggests that this component of reproductive behavior is evolutionarily labile. The reasons for evolutionary changes of this sort remain obscure.

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PATTERNS OF ABDOMINAL FUSIONS IN MALE BOREUS (MECOP-TERA).—Since publication of my comments on the fusion of terminal tergal and sternal abdominal plates in male *Boreus* (Psyche, 79: 277, 1972), I have examined two males of *Boreus vlasovi* Martynova (determined by Dr. Martynova) from Ashkhabad, Turkmeniya, U. S. S. R., through the kindness of Prof. F. M. Carpenter. Contrary to my listing based on the original description, these males do *not* have the 9th tergum fused to its sternum. Both have their 8th and 9th terga and sterna free, namely (0,0), just as in the North American *Boreus brevicaudus* Byers, *B. brumalis* Fitch, *B. nivoriundus* Fitch, and *B. notoperates* Cooper. Byer's figure (Ann. Ent. Soc. Amer. 47: 491, fig. 15, 1954) shows the North American *B. reductus* Carpenter also to be (0,0).—K. W. COOPER, Dept. of Biology, University of California, Riverside, Calif., 92502.